Testing the Efficacy of Common Insecticides Against the American Cockroach (*Periplaneta: americana*)

Isaac Eduardo Luna

Texas A&M Department of Entomology

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Abstract: The main goal of this study was to test the effectiveness of three different insecticides: baby powder, which was the control substance, silica gel, and boric acid. The ideal insecticide is not possible to achieve, but urban entomologists strive to get as close as possible to maximize environmental efficiency. Baby powder did not kill any of the cockroaches. Boric acid proved to be the best insecticide to maximize percent mortality. When compared to silica gel's 10% percent mortality, boric acid reached 78%. Although boric acid killed the most specimens, it is still important to factor in if the insecticide is safe all around, regardless of its potential to be seriously potent against pests.

Keywords: insecticides, *Periplaneta americana*, boric acid, silica gel, urban, entomology

Cockroaches (Blattodea) are one of the oldest and most successful groups of insects. There are about 4500 described species, and most are tropical. Sixty-nine species can be found in the United States, and only about 10 species have completely adapted to the human environment (Vargo. 2019) They are one of the most difficult pests to control as well. With their ability to exploit all kinds of habitats and their generalist diet, cockroaches have made their way as the second most common pest in the world of urban entomology, right behind ants (Bradt. 2018). Cockroaches serve as mechanical vectors of diarrheal diseases. When infestations exclusively inside human facilities are severe enough, they can produce odorous secretions that can affect the taste of food or be seriously unpleasant to those within the buildings. These odors and allergens produced by cockroaches can cause allergic reactions in sensitive people; allergies to cockroaches are the second most common right behind dust mites (Vargo. 2019). Therefore, there is an entomological obligation to manage this pest with low cost and non-harmful insecticides to humans and the environment (Somia. 2019). The effects of baby powder, silica gel, and boric acid as insecticides were tested against the domestic American cockroach (*Periplaneta americana L.)* Silica gel and boric acid are common insecticides used by pest management operators due to their effectiveness and low toxicity to non-target species. Baby powder was chosen as the control substance because it is nontoxic and served to compare and contrast for the other two substances. It was hypothesized that the boric acid would be the

most efficient insecticide against the common American cockroach.

Materials and Methods:

The American cockroaches', *Periplaneta: americana's (L.)*, environment was created by using a plastic container (Office depot, Boca Raton, Florida) with the dimensions 12 ¼ in., x 6 ¾ in. x, 6 ½ in. Each container included gel (Well Reptiles, Cheshire, United Kingdom) for hydration, dog food pellets (Pedigree, McLean, Virginia) for nutrition, a piece of cardboard cutout for "shelter," Teflon (Indianapolis, Indiana) to prevent the cockroaches from climbing up and escaping, and five adult American cockroaches (two females and three males for the set up specifically). Three experimental groups were asked to choose one of the three substances to add into the container: baby powder (Johnson & Johnson, Brunswick, New Jersey), boric acid (Living With Bugs, Oregon, Michigan), and silica gel (Solutions Pest & Lawn, Pasadena, Texas). There was a total of 18 containers with five specimens in each. A teaspoon of the chosen substance was obtained and placed in a straight line in between the cockroaches and their food. The cockroaches were kept for a week and monitored hourly if possible. Mortality and the number of hours until death was recorded.

Results:

A comparison of insecticides treated on *Periplaneta americana* showed variation in effectiveness. The cockroaches that had baby powder added into their container were not killed. Throughout the week, the cockroaches roamed back and forth as they walked through the insecticides. They groomed themselves to remove particles of the insecticide debris from their tarsi and antennae. The containers that received silica gel or boric acid experienced casualties. The cockroaches in these containers also demonstrated similar grooming behavior to that of those which were treated with baby powder. Percent mortality increased as the 60-hour mark was surpassed. The boric acid treatment had the highest percent mortality at about 78% when compared to 0% for the control group and 10% for the silica gel treated groups. The silica gel treated groups did not experience 50% mortality, whereas the boric acid treated group experienced 50% mortality around 100 hours. No graph is shown for the control group (baby powder) as none of the cockraches experienced casualties.

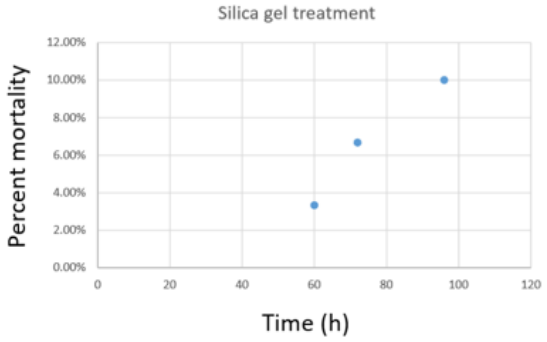

Fig 1. Percent mortality collected from the silica gel group over the timespan of a week. Urban Entomology, Texas A&M University.

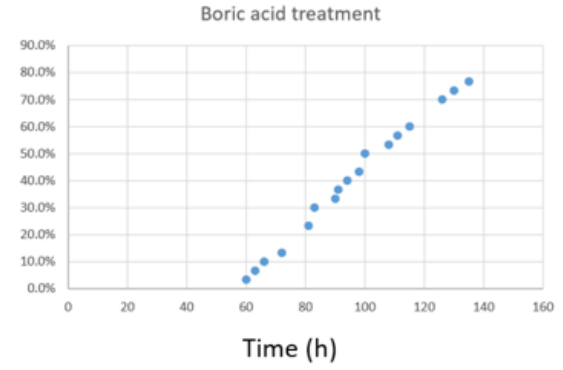

Fig 2. Percent mortality collected from the boric acid group over the timespan of a week. Urban Entomology, Texas A&M University.

Discussion:

The American cockroach is one of the most common pests in the United States behind ants. Cockroaches are considered serious mechanical vectors of pathogenic agents because of their abundance and mobility. Therefore, it is essential that urban entomologists find ways to control cockroaches in a safe and efficient manner. Urban entomologists must test out insecticides because there are so many factors that must be perfected in order to create the ideal pesticide. The ideal pesticide would have to 1) Act rapidly to kill or neutralize the pest, 2) Be harmless to non-target species, 3) Be inexpensive, 4) Be easy to prepare and apply, and 5) Be odorless and non-staining (Vargo. 2019). However, no pesticide has all of these properties.

Individuals who are constantly exposed to pesticides, such as pesticide operators and workers in the pesticide manufacturing industry take on the biggest risk of developing diseases and unwanted health issues (Hayat. 2019). But what urban entomologists do try is to maximize efficiency; maximizing benefits and minimizing costs. Because of the American cockroach's way of living, it has a critical role in transmission of infectious diseases and is also known as a vector for numerous pathogens (Somia. 2019). Urbanization is a rapidly developing phenomenon, and it continues to force humans and insects to interact. Increasing exposure to cockroaches has been strongly associated with asthma morbidity; Bla g 2 and Bla g 5 are the most relevant cockroach allergens in US patients and are associated with feces, saliva, and decaying body parts (Mortorano, Erwin. 2018).

The boric acid treatment proved most effective in killing the cockroaches with a percent mortality of 78%. This was significantly higher than the percent mortality of baby powder (0%) and silica gel (10%).

In summary, this study tested the efficacy of three pesticide substances and their effectiveness to kill off 50% of the cockroach population. It's important to control urban pests to prevent any health issues or unwanted damage to our homes. Trying to achieve the idea pesticide is no easy task, but it's crucial to test insecticides to use them to their best potential.

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